CHAPTER 1.0
INTRODUCTION

1.1 STUDY AUTHORIZATION

This study is being conducted under Section 216, Public Law 91-611, Review of Completed Projects – River, Harbor, and Flood Control Act of 1970.

1.2 STUDY OBJECTIVE

The Howard A. Hanson Dam (HHD) Additional Water Storage Project (AWSP) study was initiated by the Seattle District, U.S. Army Corps of Engineers (USACE) at the request of the City of Tacoma (Tacoma), the non-federal sponsor, in August 1989 to address how the existing federal HHD Project could meet water supply needs of Puget Sound residents. In response to a change in federal policy in 1994 making environmental restoration a higher federal priority, the study objective was expanded to include environmental (ecosystem) restoration. The Draft and Final Feasibility Reports and Environmental Impact Statements were completed in 1998. The HHD AWSP was authorized by Congress in WRDA 1999. This Conceptual Design Report examines the various fish and wildlife mitigation and restoration activities being proposed at sites in the Green River basin in conjunction with Phase I of the AWSP consistent with outcome of the FR/EIS process. Sixty five percent level design, continued consultation, and the regulatory process will confirm the viability of the proposed activities.

1.3 PROJECT LOCATION

HHD was constructed by the USACE to provide flood protection and augment flows in the Green River basin within Water Resource Inventory Area (WRIA) 9. The project is located in southern King County, approximately 45 miles southeast of Seattle, Washington (Figure G-01). The dam is located at River Mile (RM) 64.5 in Section 28, Township 21 North, Range 8 East, Willamette Meridian. The project site lies within Tacoma's municipal watershed and access to much of the over 220 square miles of watershed above HHD is closed to the public. From RM 64.5, the Green River flows west and north from the Cascade Mountains to join with the Black River to form the Duwamish River. The Duwamish River then empties into Puget Sound 12 miles downstream at Elliott Bay.

1.4 BACKGROUND

1.4.1 Project Description

1.4.1.1 Howard Hanson Dam

The USACE completed construction of HHD in 1962. The project is currently operated to provide fall and winter flood control and summer low-flow augmentation for fish resources. HHD is operated for flood control so that the sum of the dam release and local inflow downstream of the dam does not exceed a flow of 12,000 cfs as measured at the Auburn U.S.

Geological Survey (USGS) gage (RM 32). The dam provides storage of up to 106,000 acre-feet (ac-ft) for flood control from approximately October through March.

Operation of HHD during the winter is determined by flood control requirements. During the spring, the project switches from flood storage to its secondary role of conservation storage for low-flow augmentation. The existing reservoir provides for 25,400 ac-ft of summer/fall storage; 24,200 ac-ft is active storage available for augmenting instream flows below the project. During the switch from flood to conservation storage, the amount of water released from HHD is reduced below the level of inflows, allowing the project to refill. Refill timing and release rates are based on target instream flows that are adjusted yearly in response to the existing weather conditions, snow pack, amount of forecasted precipitation, and input on biological conditions from agency and tribal resource managers (USACE 1998b).

Under the Section 1135 Project, an additional 5,000 ac-ft of water may be stored during selected years (e.g., initially during drought conditions expected in one out of five years) for a total active storage volume of 29,200 ac ft. Under the adaptive management provisions of the Section 1135 Project, the frequency of storage can be increased to an annual basis if shown to be beneficial to natural resources and if all coordinating organizations agree.

1.4.1.2 Additional Water Storage Project (AWSP)

The full implementation of the proposed AWSP would provide up to an additional 32,000 ac-ft over existing storage in two phases by raising the existing summer conservation pool 30 feet (from surface elevation 1,147 feet to 1,177 feet). In Phase I, a downstream fish passage facility would be constructed at the dam and reservoir storage would be increased by up to 20,000 ac-ft for municipal water supply. Phase I would also include the option to store up to 5,000 ac-ft of water every year (Section 1135 Project water) for low-flow augmentation purposes to benefit downstream fishery resources. The full pool reservoir elevation would be raised from 1,147 feet to 1,167 feet. In Phase II, an additional 12,000 ac-ft (9,600 ac-ft available for flow augmentation for instream resource benefits, and 2,400 ac-ft for municipal and industrial [M&I] water supply) of storage would be added to the Phase I conditions (Table 1-1 and Figure G-5).

Table 1-1
Comparison of Howard Hanson Dam Summer Conservation Pool
Between the Existing Project and the AWSP Phase I and Phase II.

	Summer Conservation Pool			
Project Condition	**Conservation Storage (ac-ft)**	**M&I (ac-ft)**	**Total Volume (ac-ft)**	**Water Surface Elevation (ft)**
Existing HHD Project	25,400	0	25,400 (normal year)	1,141
	30,400	0	30,400 (drought year)	1,147
AWSP Phase I	30,400	20,000	50,400	1,167
AWSP Phase II	40,000	22,400	62,400	1,177

The AWSP, a combined water supply and restoration project, was subjected to extensive agency review and a collaborative decision-making process involving the National Marine Fisheries Service (NMFS), U.S. Fish and Wildlife Service (USFWS), Washington Department of Ecology

(Ecology), Washington Department of Fish and Wildlife (WDFW), the Muckleshoot Indian Tribe (MIT), Tacoma, and the USACE. This process resulted in the phased adaptive management plan that provides early outputs of water supply and restoration benefits with an opportunity to review and adjust the project operations as experience is gained. The key elements of the plan include experimentation, monitoring and analysis, followed by adjustment to the management and operation practices responsive to the monitoring information.

During the spring refill period, up to 32,000 ac-ft of water would be stored behind HHD; in addition, during this time up to 100 cfs (65 mgd) of water would be withdrawn through the Tacoma's proposed Second Supply Project (SSP), a 33.5 mile-long water supply project from the Tacoma Headworks to the City of Tacoma. This withdrawal of additional water would require additional water rights and would be subject to greater instream flow requirements.

The acceptance of the Phase II storage by the MIT and resource agencies would be based on the successful performance of Phase I, as determined through the Phase I monitoring. The MIT, resource agencies, Tacoma and USACE would have the final determination on implementation of Phase II of the project. The storage of an additional 12,000 ac-ft in Phase II would raise the inundation pool at HHD from 1,167 feet to 1,177 feet. The determination of adequacy of the proposed Phase II mitigation and restoration measures to mitigate Phase II actions is currently based on assumptions that would be verified by monitoring of Phase I mitigation and restoration measures.

Up to 20,000 ac-ft of Phase I municipal and industrial water would be stored in the spring under Tacoma's Second Diversion Water Right (SDWR) for release during the summer and fall to supply up to 100 cfs (65 mgd) for Tacoma's M&I water needs. The water surface elevation of the HHD pool would be raised by 20 feet (from elevation 1,147 feet to 1,167 feet). Tacoma would exercise its SDWR when municipal water is being stored during spring reservoir refill. The stored water would then be released for immediate withdrawal during the summer and fall when there is a greater need for the water.

Phase I would include all structural features required to provide a downstream fish passage facility at HHD, as well as a number of habitat restoration and mitigation projects.

Goals for operation of HHD under Phase I are to meet springtime reservoir refill objectives while providing dam releases that mimic natural flow variation. Specific objectives include:

- establish self-sustaining wild runs of chinook, coho and steelhead in the upper watershed above HHD;
- maximize the survival of pre-smolts and smolts migrating through the HHD reservoir;
- maximize attraction and passage of outmigrating salmonids (fry, pre-smolts, smolts and steelhead kelts) at the surface intake of the HHD downstream fish passage facility;
- initiate efforts to re-establish runs of historical upper Green River anadromous fish stocks;

- evaluate benefits and potential risk of artificial freshets to downstream fisheries resources;
- establish flow management guidelines to optimize use of stored low-flow augmentation for downstream fishery benefits; and
- evaluate Phase I refill effects on lower Green River anadromous salmonid fish stocks through inventory and monitoring.

Habitat restoration and mitigation projects associated with Phase I would include:

- a downstream fish passage facility (see 35% Level Design Report completed July 2000) at HHD;
- re-establish sediment and woody debris transport processes below HHD;
- flow adjustments during spring refill to:
  - > maximize outflow capacity of the fish passage facility by minimizing the reservoir refill rate during smolt outmigration and potential use of periodic artificial freshets that mimic natural freshets;
  - > increase downstream survival of outmigrating salmonids by maintaining a target base flow and provide the option to release periodic freshets during peak outmigration;
  - > partially mitigate downstream effects of storage by maintaining a target base flow that improves side channel and lateral mainstem rearing habitats;
  - > provide adequate baseflows through the steelhead incubation period that protect eggs deposited during higher spawning flows;
  - > annual storage of an additional 5,000 ac-ft (Section 1135 Storage) for low-flow augmentation;
- management of riparian forests to maintain forest succession on major streams above HHD (such management would occur in Tacoma's Natural, Conservation, and Commercial Forest Management zones);
- reconnection of approximately 3.4 acres of side-channel habitat to the mainstem lower Green River;
- habitat rehabilitation including large woody debris (LWD) placement and excavation or reconnection of off-channel habitats to selected streams between the elevations of 1,177 feet and 1,240 feet;
- return of the river to its historic channel between RM 83.0 and 84.0 using one or more debris jams/flow deflectors;
- maintenance of instream and riparian corridor habitat within the reservoir inundation zone (elevation 1,141 feet to 1,167 feet);

- maintenance of stream and riparian corridor habitat in lower Page Mill Creek, creation of a series of new, smaller ponds, and addition of woody debris to the ponds and stream channel;
- replacement of culverts that constitute barriers to upstream or downstream fish passage in tributaries to the Green River (locations to be identified from a culvert inventory);
- improvement of habitat in the mainstem Green River below HHD by constructing engineered log-jams and limited excavation to recreate meanders or backwater habitats;
- wildlife habitat mitigation including: 1) creation of elk forage habitat; 2) upland forest management to promote late-successional and old-growth forest habitat conditions; and 3) wetland and riparian habitat improvements in the reservoir inundation zone (elevation 1,141 feet to 1,167 feet) including construction of two sub-impoundments and sedge plantings over 60 acres;
- annual release of 3,900 cubic yards of gravel in the lower Green River; and
- transport and/or placement of woody debris (collected in HHD reservoir) in the lower Green River.

All Phase I restoration and mitigation projects would be monitored for at least 10 years, and some up to 50 years, after implementation depending on the project. Some of the activities also require pre-construction studies and monitoring, which are currently underway or planned.

A comprehensive adaptive management and monitoring plan will be developed by Tacoma and USACE over the next two years. The initial plan was described in Section 10, Appendix F, of the DFR/DEIS (USACE 1998a) and in Section 2 of the FEIS. The plan has been refined some through coordination by the City of Tacoma (Tacoma 2000). Resource agency and tribal staff will be involved during final development of the plan.

1.4.2 Consultation Under Section 7 of the Endangered Species Act

A Programmatic Biological Assessment (PBA) (USACE 2000) was prepared by the USACE in April 2000 to facilitate formal consultation with the Services on implementation of the AWSP. A number of listed fish and wildlife species are known to occur in the area influenced by HHD, or could occur there in the future. The NMFS designated the upper Green River watershed above HHD as critical habitat for Puget Sound chinook salmon effective March 17, 2000 (50 CFR 226). Ongoing operation of HHD has the potential to affect these listed species by altering flows in the lower Green River, interrupting natural ecosystem functions, and isolating critical habitat above HHD. The AWSP would further influence flows in the Green River and increase the area of inundation behind the dam, thereby creating the potential for additional effects on listed species.

The PBA covered two species of fish, three species of birds and three species of mammals (Table 1-2). Six of these species are listed as threatened, one is listed as endangered and one is proposed for listing as threatened. All eight species are known to occur in the vicinity of HHD, or could potentially occur there in the future.

A supplemental Biological Assessment (BA) will be prepared for the fish and wildlife habitat projects.

Table 1-2
Species Covered by the Howard Hanson Dam PBA.

Common Name	Scientific Name	Federal Status
Chinook Salmon	*Oncorhynchus tshawytscha*	Threatened
Bull Trout	*Salvelinus confluentus*	Threatened
Bald Eagle	*Haliaeetus leucocephalus*	Threatened
Northern Spotted Owl	*Strix occidentalis caurina*	Threatened
Marbled Murrelet	*Brachyramphus marmoratus*	Threatened
Grizzly Bear	*Ursus arctos*	Threatened
Gray Wolf	*Canis lupus*	Endangered
Canada Lynx	*Lynx canadensis*	Proposed Threatened

Table 1-3 summarizes the determinations of effect of the AWSP based on evaluations of potential effects both without and with conservation measures. The Environmental Baseline of the AWSP assumed that there were no upstream or downstream fish passage facilities at HHD and that woody debris and gravel-sized sediments would continue to be intercepted by HHD. Although the upper Green River watershed is listed as critical habitat for Puget Sound chinook by the NMFS, the lack of fish passage facilities isolates the habitat from adult chinook in the lower river. The combination of these impacts led to a USACE determination of likely to adversely affect for Puget Sound chinook and bull trout.

The Services will be providing a Biological Opinion (BO) for each of the listed species. The expected date of delivery for the BOs is summer 2000. If the BOs require or recommend changes in the AWSP habitat restoration or monitoring plans, the USACE will attempt to incorporate those changes during the next design phase (65%). Changes will not be made to this Conceptual Design Report, as this document will likely be completed prior to receipt of the BOs.

One objective of Phase I of AWSP is to provide storage of up to additional 20,000 acre-feet of water storage during the spring and summer to meet municipal water needs. The increased storage will raise the reservoir pool level during the spring and summer and will increase the duration of inundation of some stream reaches. Downstream migrating salmonids will have to pass through the larger pool and may experience delay or mortality, but the proposed downstream fish passage facility is designed to maximize opportunities to pass fish through the HHD reservoir and project. With the implementation of conservation and monitoring measures, the proposed AWSP would restore the opportunity for naturally spawning, anadromous fish populations to use critical habitats above HHD. Conservation and monitoring measures are also proposed to partially restore ecosystem functions that affect salmonid habitats in the lower river. Implementation of those restoration measures lead to a determination of not likely to adversely affect for salmonid species.

Table 1-3
Summary Determination of Effect for the AWSP

Species Name	Determination	
	Environmental Baseline (without conservation measures)	**With Conservation Measures**
Chinook Salmon	may affect, likely to adversely affect	may affect, ***not*** likely to adversely affect
Bull Trout	may affect, likely to adversely affect	may affect, ***not*** likely to adversely affect
Bald Eagle	may affect, ***not*** likely to adversely affect	may affect, ***not*** likely to adversely affect
Northern Spotted Owl	may affect, ***not*** likely to adversely affect	may affect, ***not*** likely to adversely affect
Marbled Murrelet	may affect, ***not*** likely to adversely affect	may affect, ***not*** likely to adversely affect
Grizzly Bear	may affect, ***not*** likely to adversely affect	may affect, ***not*** likely to adversely affect
Gray Wolf	may affect, ***not*** likely to adversely affect	may affect, ***not*** likely to adversely affect
Canada Lynx	no effect	no effect

The listed avian and mammalian listed species may also be affected by the increased reservoir storage for municipal water supply. The AWSP will inundate about approximately 300 surface acres of habitat, affecting areas that have been inundated during past fall and winter flood control operations. Mitigation measures proposed as part of the AWSP and described in this report will offset the effects of increased inundation and the opportunity to restore naturally spawning, anadromous fish populations will improve foraging opportunities for bald eagle and grizzly bear.

1.4.3 Activities of Others in the Green River Basin

1.4.3.1 Tacoma Water

Tacoma Water (Tacoma) operates a municipal and industrial water supply project with an intake at RM 61.0 approximately 3.5 miles downstream of HHD. To protect the quality of water in the Green River, Tacoma also manages approximately 14,888 acres of the watershed above HHD. Tacoma's activities on the Green River are referenced because the activities of the USACE and Tacoma are interrelated, particularly with respect to the AWSP and the Section 1135 Project. Tacoma would be the local sponsor for the AWSP, and the USACE would be storing water available to Tacoma under Tacoma's surface water rights on the Green River when it stores water under the AWSP. Tacoma would contribute funding for the AWSP and many of the project features, including the larger summer conservation pool area, would take place on Tacoma property in the upper watershed.

Tacoma submitted a Habitat Conservation Plan (HCP) to the Services in 1999 in support of an application for an Incidental Take Permit (ITP) under Section 10 of the ESA. The Services have published the HCP and an accompanying Environmental Impact Statement (EIS) for public review and comment. The public comment period ended on March 31, 2000. It is anticipated that the Final HCP and EIS will be issued in the Fall of 2000. The decision whether or not to issue the ITP will be made by the Services after review of the document and the comments received from the public.

All USACE activities, under the AWSP, with the potential to affect listed species were addressed in the PBA developed by the USACE in April 2000, even though many of the same activities were also discussed in Tacoma's HCP. The ITP, requested by Tacoma under ESA Section 10, cannot provide incidental take coverage to the USACE. As a federal entity, the USACE must obtain incidental take coverage in the form of an Incidental Take Statement through Section 7. All on-going and proposed USACE activities with the potential to affect listed species must be addressed through the Section 7 process to receive incidental take coverage.

1.4.3.2 King County

King County was the local sponsor for the original construction and operation of HHD as a flood control structure. The county and several local municipalities also maintain a series of levees along the Green River that function in coordination with HHD to regulate floods and protect capital improvements in the lower watershed. Since the current operation of the levee system is entirely by non-federal entities, it is not subject to the requirements of Section 7.

King County is the local sponsor of a joint USACE/County basin-wide ecosystem restoration study, termed the Green-Duwamish Basin General Investigation Study. The county, the USACE, and other interested parties are also involved in the State/County coordinated WRIA 9 salmon recovery process. One objective of the WRIA 9 recovery process is to identify and support the implementation of opportunities to improve or enhance habitat for fish and wildlife in the lower Green River. Some of these enhancement opportunities could involve modifications to the levee system to allow partial returns to "natural" flood patterns in areas where this would not conflict with other land uses. If implemented, the enhancement opportunities could be joint ventures between the USACE and the county, and could be at least partially funded by the USACE. A separate Section 7 consultation with the Services is underway to address the effects of the Green-Duwamish GI Study on listed species.

1.4.3.3 Other Landowners in the Upper Green River Watershed

The USACE owns and manages only 407 acres (0.3%) of the upper Green River Watershed; most of which is immediately surrounding HHD and its associated support facilities. The majority of the upper watershed is owned by Plum Creek Timber Company (35.8%), the federal government (20.7%; administered by the U. S. Forest Service), the State of Washington (14.1%; administered by the Department of Natural Resources), Giustina Resources (10.4%), Tacoma (10.1%), Weyerhaeuser Company (5.7%), and a number of smaller interests (2.9%).

The activities of some of the major landowners in the upper watershed have previously been subjected to review under Section 7 or Section 10 of the ESA. The Northwest Forest Plan, which governs the management of U. S. Forest Service lands throughout the range of the northern spotted owl (*Strix occidentalis caurina*), was the subject of a Section 7 review in 1994. Plum Creek lands are covered by an ITP issued in 1996, and managed according to an HCP completed in support of the ITP. Washington DNR lands are similarly covered by an ITP and managed according to an HCP completed in 1996. As noted above, Tacoma lands in the upper watershed are the subject of a draft HCP currently under review by the Services. If the HCP is

approved, Tacoma would receive an ITP for the continued operation of the water withdrawal facility and management of its lands in the watershed.

1.4.4 Environmental Setting

1.4.4.1 Climate and Topography

The climate of the Green River basin is dominated by maritime influences of the Pacific Ocean and topographic effects of the Cascade Mountains. Regional climate is characterized by cool, wet winters and mild, dry summers. Precipitation is mostly derived from cyclonic storms generated in the Pacific Ocean and Gulf of Alaska that move inland in a southwest to northeast direction across western Washington. Approximately 74 percent of precipitation that falls at Seattle-Tacoma Airport falls during the period of October 1st through April 30th. During summer months, a regional high pressure system generally resides over most of the eastern Pacific, which diverts storms and associated precipitation to the north. The weakening and northerly migration of the polar jet stream is another reason for the pleasant summer weather.

This regional climatic pattern is modified by the presence of the Cascade Mountains, which rise to an elevation of approximately 5,000 feet at the eastern margin of the Green River basin. Moist, maritime air cools and condenses as it moves up in elevation from west to east through the basin, resulting in decreasing temperatures and increasing precipitation up this elevation gradient. Consequently, there is a considerable difference in both temperatures and precipitation from the lower to the higher elevations of the basin (Table 1-4). In addition, there is more snow in the upper portion of the basin. Spring rains and the resulting surface runoff are the major source of water to streams in the spring. The climatic pattern and topography interact to determine a runoff pattern that results in wet winters and dry summers. This runoff pattern affects the strategy of storing water for augmenting low summer instream flows and municipal water supplies.

Table 1-4
Temperatures and Precipitation in the Green River basin

Location	Elevation (feet)	Period of Record	Mean July Max. Temperature (°F)	Mean Jan. Min. Temperature (°F)	Mean Annual Precipitation (inches)	Mean Annual Snowfall (inches)
Seattle-Tacoma Airport	400	1961-1990	75	35	38	10.4
Palmer 3ESE	920	1961-1990	75	31	88.27	43
Stampede Pass	3,958	1961-1990	65	20	92.57	442

Source: Western Regional Climate Center, 1998.

1.4.4.2 Geomorphology and Land Use

Geomorphology

Soils in the upper Green River basin, defined as the area above HHD, are largely derived from volcanic parent material and occur on mountainous slopes that become quite steep toward the crest of the Cascade Mountains. The upper basin also includes terraces in the underlying lava and bedrock created by glacial scouring and by wave action in large Pleistocene lakes that

developed between the glacial lobe and the Cascade Mountains. Many locations of bedrock outcrop also exist. The upper Green River and its tributaries have relatively narrowed to nonexistent floodplains that are confined by the steep valley sides.

The potential for erosion hazard is high or severe on many soils where the slopes are greater than 35 percent (USFS 1996). These soils often slump or slide in rainy periods after vegetation has been removed. Soil depths range from shallow soils associated with rock outslopes and talus slopes to very deep (>12 feet) valley bottom soils.

The lower Green River is defined as the reach below HHD extending downstream to the Puget Sound. In the lower Green River basin from Palmer to near Auburn, soils are largely derived from unconsolidated glacial material and occur on more gradual slopes characterizing the rolling topography in this area (SCS 1973). Soils in the Everett association, which are gravelly sandy loams formed in glacial outwash deposits, dominate the uplands surrounding the Green River floodplain. Floodplain soils in the middle basin are in the Oridia-Seattle-Woodinville association, which consists of somewhat poorly drained to very poorly drained silt loams, mucks, and peats. There are also strips of gravel and sand deposited along channels, which are typically quite narrow but average nearly 1,000 feet in width (nearly one-third of the floodplain) near the confluence of Newaukum Creek (Mullineaux 1970).

The floodplain of the lower Green River varies considerably in width. The Green River Gorge has virtually no floodplain, due to the rapid downcutting through relatively weak sandstones and mudstones. Downstream of the Gorge, the river has developed a broad floodplain in a valley that is typically about 0.5 mile in width.

In the lower Green River basin below the confluence of Soos Creek, soils are also in the Oridia-Seattle-Woodinville association developed from fine-textured alluvial material deposited by the Green, White, and Cedar rivers, with organic soils in depressional areas. Soils in this reach of the lower Green River basin have high agricultural potential, although urban development has now eliminated much of the previous agricultural land use in the area.

Prior to settlement by Euroamericans, the floodplain of what was once the lower White River probably covered most of the floor of what is now the Green River Valley north of Auburn, which averages about two miles in width. Due to the construction of levees, dredging of channels, and flood control by HHD, this floodplain is now essentially inactive.

Land Use

Most of the land (99 percent) in the upper Green River basin is managed as a water supply area for Tacoma and for commercial timber production. Ownership in the upper basin is divided among several private and public entities, including Plum Creek Timber Company (34 percent), USFS (22 percent), Washington State Department of Natural Resources (14 percent), and City of Tacoma (10 percent) (Tacoma 1998). The remaining 19 percent is mostly owned by other timber companies.

Tacoma owns 10 percent of the upper watershed, and has intentionally concentrated its holdings in lands adjacent to the Green River and the HHD reservoir. Tacoma manages these lands

according to Tacoma's Green River Watershed Forest Land Management Plan to protect water quality and, where consistent, conduct commercial timber harvest.

Lands owned by other entities, such as the USFS and Plum Creek Timber Company, are also managed for timber production. USFS land is managed under the June 1990 Land and Resource Management Plan for the Mt. Baker-Snoqualmie National Forest as amended by the April 1994 Record of Decision for Management of Habitat for Late-Successional and Old-Growth Forest Related Species Within the Range of the Northern Spotted Owl (i.e., the Northwest Forest Plan). Private and state timber lands are managed according to the Washington State Forest Practices Rules and Regulations (Title 222 WAC) and other management directives (i.e., Habitat Conservation Plans [HCP]) developed to comply with the federal Endangered Species Act (ESA) of 1973 as amended.

In the lower Green River basin, almost 80 percent of the land use is rural, forest production, and urban/residential. The middle Green River basin has one of the largest remaining agricultural communities in King County and is of increasing importance as an affordable area for suburban and rural residences and hobby farms.

The majority of the lower Green River basin below the Soos Creek confluence is urban residential, but there is also a substantial amount of rural and agricultural land use. Land use in the lower 11 miles of the basin is predominantly urban-residential, with heavy industrial use along the river. However, even in this urban/industrial setting, over 20 percent of the land is classified as rural.

1.4.4.3 Plant Communities

The upper Green River basin is within the Western Hemlock Forest Zone (Franklin and Dyrness 1987). The Western Hemlock Forest Zone is characterized by climax western hemlock (*Tsuga heterophylla*) and western red cedar (*Thuja plicata*) forests and sub-climax Douglas-fir (*Pseudotsuga menziesii*) forests. Although western hemlock is the potential climax species in this zone, Douglas-fir forests cover large areas of the landscape. Douglas-fir-dominated forests develop following disturbance, such as fire and clearcut logging practices, and can persist for several centuries. Hardwood forests are commonly restricted to moist, early successional sites, where red alder (*Alnus rubra*) often dominates and big-leaf maple (*Acer macrophyllum*) is common. Topography, aspect, geology, soil, and available groundwater all influence plant community patterns at the local level, particularly for understory species. Common understory species include sword fern (*Polystichum munitum*) in moist sites, salal (*Gaultheria shallon*) in dry sites, and Oregon grape (*Berberis nervosa*) in sites with intermediate moisture status. Vine maple (*Acer circinatum*) is a common shrub in the middle understory.

Disturbance has had a major impact on forest patterns in the upper Green River basin due primarily to extensive timber harvest and past wild fires. Timber harvest activities have resulted in the predominance of second-growth, even-aged coniferous stands. There is also a large area of hardwood dominated by red alder with an understory of western hemlock and western red cedar present. The majority of the stands are 30 to 90 years old and, until about 30 years ago, regenerated naturally. More recent harvested areas have been planted with Douglas-fir.

Deciduous forests comprised of red alder, big-leaf maple, and black cottonwood (*Populus balsamifera*) occur on wetter slopes.

1.4.4.4 Hydrology

The Green River originates in the high Cascades in central Washington state, and flows northwest for approximately 93 miles, draining an area of over 460 square miles before emptying into Puget Sound at Elliot Bay. Forty-eight tributaries enter the system above HHD, feeding both the mainstem and reservoir. Large headwater tributaries include the North Fork of the Green River, and Sunday, Smay, Charley, Gale, Twin Camp, Sawmill and Friday creeks (Figure G-04). These tributaries lie within the snow zone and exhibit two distinct discharge peaks associated with fall rainstorms and spring snowmelt.

Below HHD, major tributaries include Newaukum and Soos creeks, which enter the middle Green River near RM 41 and RM 34, respectively. A number of flow-related problems have been associated with the increasing urban development in lower basin tributaries such as Soos Creek (King County 1989). With increasing impervious surface area, water runs off more quickly and less is captured and stored by wetlands or alluvial aquifers, reducing groundwater contributions that maintain summer low flows. Increased impervious area and ground water withdrawals were cited as the primary cause of recent declines in summer low flows in Soos and Newaukum Creeks (Culhane 1995). Channels become wider in response to the increased peak flows, and scour of spawning gravel may occur more frequently.

In addition to USACE measurements of reservoir levels behind HHD, the U.S. Geological Survey (USGS) maintains a series of stream gages in the Green River Basin. The most important gages from the standpoint of Howard Hanson project operations are located on the mainstem Green River at RM 60.3 near Palmer (12106700) and at RM 32 near Auburn (121130000). The Palmer gage is used as a flow control target for the USACE low-flow augmentation. The Auburn gage is used as a target site for flood control operations and as a target site for instream flow requirements. The Auburn gage is just downstream of the majority of current anadromous salmonid spawning habitat, and upstream of the highest density urban areas. Analyses of the effects of the AWSP in HHD operations use the Auburn gage as a control point to maintain consistency with documents produced earlier by the USACE and Tacoma Public Utilities (USACE 1998a; Tacoma 1999).

1.4.4.5 Water Quality

The Washington State Department of Ecology (Ecology) has established surface water quality standards pursuant to Chapter 90.48 RCW (Water Pollution Control Act) and Chapter 90.54 RCW (Water Resources Act of 1971) to protect uses of water beneficial to wildlife and humans. Water quality standards affected by forest practices are addressed by the Washington Forest Practices Board Manual, which states that “whereas Ecology is solely responsible for establishing water quality standards for waters of the state, both the Forest Practices Board and Ecology shall jointly regulate water quality issues related to silviculture in the State of Washington (RCW 90.48.420)." As a result, WAC 173-202, Washington Forest Practices Rules and Regulations to protect Water Quality, was jointly developed and adopted by the Forest

Practices Board and Ecology so that compliance with Forest Practices Rules and Regulations would in turn achieve compliance with water pollution control laws.

Water Quality Standards for Surface Waters of the State of Washington (Chapter 173-201A WAC), classify the Green River as Class "AA" (extraordinary) upstream of RM 42.3 (Flaming Geyser State Park), Class "A" (excellent) between Flaming Geyser State Park and the Duwamish River confluence (RM 42.3 to 11.0), and Class "B" (good) within the Duwamish River (WAC 173-201A-130). These specific classifications are meant to define present and potential uses of these waters and do not necessarily define natural conditions. For example, WAC 173-201A-030 states that Class B waters shall meet or exceed the requirements for most uses (beneficial uses, as described in WAC 173-201A-030, include, but are not limited to: agricultural and industrial water supply; stock watering; fish and shellfish habitat; wildlife habitat; and secondary contact recreation). Class AA waters shall markedly and uniformly exceed the requirements for all or substantially all uses (identical to those listed for Class B waters, but in addition include domestic water supply and primary contact recreation). These classifications indicate that the Green River has sufficient water quality to support current uses of the river; however, several areas (primarily below Auburn) have been identified where water quality may be limiting to beneficial uses of the river during certain times of the year (USACE 1995; and discussed below).

In general, water quality problems that potentially contribute to the decline of salmonids in the Green River increase in severity as the water flows downstream. In the upper watershed, the primary factors affecting water quality and fish production are increased turbidity and fine-sediment loading associated with commercial forest management. Water quality in the lower watershed is influenced by a number of land and water uses and is degraded in the form of:

- Increased summer water temperatures due to removal of riparian vegetation, diversion of the White and Black rivers, and release of warmer water later in the summer from HHD storage. Water temperatures exceeding the state standard have been recorded frequently enough to warrant registering lower segments of the Green River on the state's 303(d) lists; and
- Reduced DO due to elevated water temperatures and increased biochemical and chemical oxygen demand associated with high nutrient and pollutant inputs. DO levels that fail to comply with the state standard have also been recorded in the lower watershed during sustained low-flow periods. However, these failures have not been recorded frequently enough to warrant placement on the state's 303[d] list).

Furthermore, disconnection of the floodplains by reduced flooding, plus the physical removal of wetlands (particularly in the lower basin) has reduced the natural capacity of the system to store and treat water entering and flowing through the river system. In addition to fisheries impacts, poor water quality has also influenced the aquatic macroinvertebrate community in the lower and middle basins.

In the 1980s, water quality and sediment monitoring identified pollution in the Duwamish River and Elliott Bay (Duwamish River and Elliott Bay Water Quality Assessment Team [WQAT] 1999). The pollution originated from a number of point and nonpoint sources. Recent improvements in wastewater and stormwater treatment facilities and processes (e.g., secondary

treatment of wastewater, rerouting treatment plant effluent from the river to Puget Sound, sediment cleanup and capping of contaminated areas, and other measures [WQAT 1999]) have had a noticeable effect on improving water quality in the Duwamish River and Elliott Bay. Using water quality data collected weekly in 1996 and 1997 from 21 stations throughout the Duwamish Estuary, the WQAT concluded that there are currently minimal risks to aquatic life from chemicals in the water column. In particular, the WQAT found no risks to juvenile salmon from direct exposure to chemicals in the Duwamish River or Elliott Bay (WQAT 1999).

Water Temperature

Summer water temperatures in the Green River increase progressively as the water travels downstream. Based on data reported by the USACE (1995), water temperatures in the Green River above HHD are generally below 60°F (16°C). However, inflows into the HHD reservoir do exceed 60°F (16°C) during the summer in most years. Such periods are generally brief and do not appear to greatly affect reservoir temperatures. Temperatures in the lower levels of the reservoir during the summer are between 50° and 55°F (10 and 12.8°C), which is 15°F (9.4°C) below surface temperatures during the same time period. Surface temperatures fluctuate more than deeper layer temperatures, and reservoir stratification is generally weaker than in natural lakes (USACE 1998a). A more thorough assessment of temperature conditions in the Green River can be found in the Additional Water Storage Project (AWSP) DFR/DEIS, Appendix D3, Section 1 (USACE 1998a).

The HHD impoundment becomes thermally stratified in late spring or early summer, and remains in this condition through early fall. The stratification results in layers of water at elevated temperatures occurring at the surface and overlaying colder bottom waters. Mixing of the layers is prevented by density gradients. Because the release from the reservoir is achieved through low level outlets, downstream temperatures during the early summer period are colder than those that would have occurred without the project. Profile measurements made in the forebay over the 17-year time span June 21, 1967, through July 26, 1983, recorded a maximum surface temperature of 74°F (23.6°C) and a maximum bottom temperature of 62°F (16.5°C). Minimum recorded temperatures during this period were 41°F (5°C) at the surface and 40°F (4.5 °C) at the bottom of the pool (USACE 1998b).

Low-flow releases from HHD during the summer conservation period are made through a 48-inch bypass intake located about 35 feet above the bottom of the pool. The 48-inch bypass pipe is located below the level of typical reservoir stratification. As a result of drawing water from the lower, colder stratum, releases from HHD during the early summer are usually below expected natural temperatures. Later in the summer and in early fall, as cooler water is depleted and warmer water is released, temperatures are higher than would be expected under a natural, unimpounded flow regime (USACE 1998a). These artificially higher temperatures can adversely affect salmon spawning behavior and may accelerate maturation of developing salmon eggs.

High water temperatures in the lower Green River probably result from solar heating of the river during summer low-flow periods. The factors responsible for this warming include extensive paved areas in the lower Green River basin that reduce groundwater recharge and subsequent discharge of cool groundwater into the river, low summer flows, and lack of shade along the lower river (USACE 1998a).

Caldwell (1994) studied temperatures between HHD and the confluence with the Duwamish River. Between HHD and the Tacoma Headworks (3.5 river miles below the dam), summer water temperatures averaged 57 to 65°F (13.9 to 18.3°C). Caldwell found water temperatures at the Tacoma Headworks to be independent of HHD outfall temperatures.

Water temperatures above 60°F (15.5°C) are limiting for cold water-adapted fish, such as salmon and steelhead and also contribute to low DO, another potentially limiting water quality parameter. Elevated temperatures may also result in algae blooms, a particular concern in the lower Green River and in the Duwamish River. It is also thought that high water temperatures affect the movement of migrating adult salmonids, particularly during August and early September and may affect salmon egg viability and survival (Caldwell 1994).

Dissolved Oxygen

Measurement of 75 dissolved oxygen (DO) profiles in the dam forebay over an eleven-year period since the dam was completed have yielded a profile average of 9.52 mg/l. Extremes ranged from a maximum surface concentration of 12.5 mg/l to a lake bottom minimum of 4.4 mg/l. Outflows from the project, due to re-aeration in the tailrace, have generally ranged slightly higher than reservoir DO levels. Statistics of DO concentrations for the monitoring station below the dam indicate a mean of 10.69 mg/l with a maximum of 13.7 mg/l and a minimum of 7.95 mg/l. These figures indicate that DO is not a problem in release waters (USACE 1998b).

Saltwater Wedge

The lower several miles of the Duwamish River estuary (approximately downstream from the head of navigation) are comprised of a salt-water wedge overlain by a fresher-water layer. Stratification is strong during high freshwater inflows, which also push the wedge downstream relative to conditions during lower flows. Net circulation in the wedge is upstream due to entrainment of saltwater from the wedge to the overlying fresher-water. Net movement of the fresher-water is downstream. Circulation in the estuary and resultant water quality of the saltwater wedge is principally controlled by freshwater inflow rate, tidal action and estuary morphology.

Freshwater is principally supplied to the Duwamish estuary by the Green River. Flows in the Green River average 1,549 cfs (43.9 m^3/sec) at Tukwila with peak flows exceeding 12,000 cfs (343 m^3/sec) and minimum flows as low as 195 cfs (5.5 m^3/sec). Peak flows occur during winter months while low-flows occur during August and September. Flows have been regulated by the HHD since 1961, for flood control and during summer months to augment natural river flow (Harper-Owes 1981). Low-flows augmented by releases from HHD improve the circulation and water quality of the saltwater wedge.

Total Dissolved Gases

Although no measurements have been taken, Total Dissolved Gases (TDG) are not believed to be a concern due to the discharge design of HHD. The physical conditions of flow release and energy dissipation, which have caused supersaturation conditions at other dam projects, do not exist at HHD.

Turbidity
Turbidity is the only water quality parameter that has seasonally exceeded Class "AA" standards in the Green River above HHD (USACE 1995). Periods of high turbidity are generally associated with winter storms and snowmelt.

In the lower Green River, turbidity is not generally limiting to fish, though it may limit other uses such as water supply and recreation. Turbidity is of greatest concern during flood events and when HHD reservoir levels are low, both of which can result in river water at the Headworks being too turbid for use by Tacoma Water. When this occurs, Tacoma uses water from the North Fork Wells located in the upper North Fork Green River basin until turbidity levels fall to acceptable levels. A detailed discussion of turbidity effects from operation of the HHD can be found in Appendix D3, Section 2 of the AWSP DFR/DEIS (USACE 1998a) and in Section 4.3.4 Sediment Management.

Turbidity levels in the tailwater of HHD are currently the only known parameter to exceed the Department of Social and Health Services (DSHS) raw water quality standards. While turbidities were excessive during high flow conditions without the dam, because of stored water being released after flood regulation activity, the period of high turbidity is extended until the storage is evacuated or sufficiently diluted by cleaner inflows.

Contaminants
Analytical results indicate that waters impounded in HHD reservoir are of very good chemical quality and suitable for most purposes. The water is soft, has a low dissolved mineral content, only mildly buffered, and essentially neutral in pH. Low concentrations of dissolved nutrients and absence of algae blooms are indicative of an oligotrophic system, one that is low in primary productivity. Waters stored in the reservoir and released to the river meet the water quality criteria established by the State for class AA (extraordinary). Chemical analyses are performed annually by Tacoma to evaluate the chemical composition of the reservoir release. Past records indicate that the raw water quality conforms to State inorganic chemical criteria (USACE 1998b).

Ecology has measured levels of mercury, copper, lead, and zinc above state-established standards in the Duwamish River (USACE 1995). However, concentrations of most of these metals have not exceeded state standards frequently enough to warrant placement on the state's 303(d) list for 1998. The metal of most concern in the Green River is mercury. King County and Ecology have reported mercury at levels above state standards in the lower Green River. These sampling results have put the lower Green River (waterbody segment WA-09-1020) on the state's 303(d) list for mercury. One source of mercury was the Renton Treatment Plant, which discharged wastewater into the Black River/Springbrook Creek until 1987. An additional source of metals into the river may be leachate from the now closed Kent Highlands Landfill.

Toxic contaminants have been identified in bottom sediments and surface water in the lower Green River and especially in the Duwamish River (USACE 1995). Chemical testing of bottom sediments in the lower 5 miles of the Duwamish River revealed contamination by oil and grease, sulfides, pesticides, and polychlorinated biphenyls (PCB). More recently, Ecology cited

excursions beyond criteria in sediment for polychlorinated biphenyls and polyaromatic hydrocarbons. Potential contamination sources are common along industrialized sections of the Duwamish River, which is currently being addressed as part of the EPA's *Elliott Bay Toxics Action Plan* as well as other programs addressing remediation and source control for toxic contaminants. Runoff from agricultural and other developed areas are also thought to be sources of toxic contaminants in the lower Green River.

1.4.4.6 Fisheries Habitat

The historical fisheries habitat within the Green River basin is presumed to have been excellent for anadromous salmon and trout, resident trout, and other cold water native species (USACE 1996). Over 30 species of fish historically or currently inhabit the Green River, including up to nine anadromous salmonid species. Currently chinook, coho, chum, pink and sockeye salmon, steelhead and coastal cutthroat trout may be found at various times of the year in portions of the Green River. Native char (bull trout and/or Dolly Varden) have been occasionally observed to enter the lower Green/Duwamish River. Native resident salmonids include rainbow and cutthroat trout and mountain whitefish. Other native fish species are also present, including lamprey, minnows, sculpins, and suckers. Natural spawning anadromous fish have been recognized as a critical link in the aquatic food webs of the Pacific Northwest aquatic ecosystem. They are considered a "keystone" species upon which producers and consumers from the bottom to the top of the food chain depend.

Rearing in the ocean, adult anadromous salmon return to streams with ocean nutrients, enriching the food web from primary producers to top carnivores. At the top of the food web, at least 22 species of wildlife, including black bear, mink, river otter, and bald eagle, feed on salmon carcasses (Cederholm et al. 1989). At the base of the food web, salmon carcasses provide a major amount of nitrogen to streamside vegetation, and large amounts of carbon and nitrogen to aquatic insects and other macroinvertebrates (Bilby et al. 1996). Some researchers suggest that a minimum escapement level for natural spawners may be needed to maintain the integrity of the aquatic food chain.

In addition to their importance to genetic diversity and biological cycles, local salmon and steelhead harvests in the Green/Duwamish basin provide for commercial, sport, subsistence, and cultural uses to people. In particular, Muckleshoot and Suquamish Tribal people have treaty fishing rights to Green River fish, which are important to their economic and cultural sustenance.

In response to the declining status of these valuable species, the U.S. Fish and Wildlife Service (USFWS) listed bull trout (64 FR 58910) and National Marine Fisheries Service (NMFS) listed Puget Sound chinook salmon as threatened (63 FR 11482) requiring protection under the ESA. These proposed and listed stocks include any populations of these species that may reside in the Green River.

The Green/Duwamish river basin lies within the southernmost portion of the North Cascades ecoregion in the Puget Sound basin (USACE 1996). This ecoregion (an area with distinct climate, wildlife, and plant populations) is an important producer of fish and wildlife resources. Anadromous fish species historically had access to the upper basin above the Headworks.

However, anadromous fish access to the upper Green River is now blocked by HHD at RM 64.5 (completed in 1962) and the Headworks at RM 61.0 (completed in 1912).

The middle Green River basin includes the 13-mile long Green River Gorge. The middle Green River basin and lower Green/Duwamish basin lie within the Puget Lowland ecoregion, which is characterized by open hills and flat lacustrine and glacial deposits. This region once contained extensive wetlands, however the lower portion of the basin was historically developed for agricultural use. Much of the forested areas were cleared for pastureland, and riparian zones were restricted by levees. Much of the lower basin has since been developed as urban areas and includes the cities of Auburn and Kent (USACE 1996). The Duwamish River historically consisted of extensive salt water and brackish marshes.

The lower Green/Duwamish rivers served as a transportation corridor and were probably extensively used by juvenile salmonids (Grette and Salo 1986). Tidewater fish that likely used the estuary of the Duwamish River include smelt (*Osmeridae*), sole (*Pleuronectidae*), sanddab (*Bothidae*), goby (*Gobiidae*), sculpin (*Cottidae*), Pacific sandlance (*Ammodytes hexaperterus*), and tube-snout (*Aulorhynchus flavidus*) (Grette and Salo 1986).

1.4.5 Current Structural Setting

The two most obvious structural features that have been built on the Green River are the HHD at RM 64.5 and the Tacoma Headworks at RM 61. Other structural features that affect the flow of water in the Green River include the Burlington Northern Santa Fe (BNSF) Railroad line in the upper basin and the levee system in the lower basin.

1.4.5.1 Howard Hanson Dam

HHD is a subsidiary earth-filled structure composed of rolled rock fill, sand and gravel core, drain zones, and rock shell protection (USACE 1998b). The embankment is 235 feet high and 500 feet long and has an inclined core of sand and gravel material. The dam is 960 feet thick at the base decreasing to 23 feet thick at the crest. The total length of the dam is 675 feet. The intake structure also includes trash rack bars, a deck for debris removal, one tractor-type emergency gate, and gate hoist equipment located in the gate tower.

The outlet structure consists of a gate tower and intake structure with two tainter-type gates, a concrete horseshoe-shaped outlet tunnel, a gate-controlled bypass, and a stilling basin. No upstream or downstream fish passage facilities were included in the original project design.

The 900-foot-long, 19-foot-diameter flat bottom horseshoe-shaped outlet tunnel passes normal flow released for project regulation. The tunnel is controlled by two 10-foot-wide by 12-foot-high regulating tainter gates at the bottom of the reservoir pool (invert elevation 1035 feet) above mean sea level (MSL).[1] Low-flow releases during the summer conservation period are made through a 48-inch bypass intake located about 35 feet above the bottom of the pool. This outlet has a capacity of approximately 500 cfs at maximum conservation pool (elevation 1,141 feet).

[1] Elevations referenced in this document refer to a mean sea level datum.

The gate-controlled spillway is anchored in rock on the left abutment and in a concrete monolith adjacent to the embankment. The spillway is a concrete ogee overflow section with two 30-foot-high by 45-foot-wide tainter gates to control major flood flows and prevent overtopping of the dam. The lowest elevation of the gates is 1,176 feet. The downstream chute has a curved alignment and is paved for a distance of 712 feet downstream from the weir. The tainter gates permit storage to elevation 1,206 feet without spillway discharge. The reservoir provides 106,000 ac-ft of flood control storage at elevation 1,206 feet. The highest pool elevation attained was 1,183.5 feet in 1996. The maximum spillway discharge is 115,000 cfs at the spillway design flood pool elevation. Floating debris is collected during periods of high water by three stationary booms in the reservoir just upstream of the dam.

The dam and reservoir area includes various gravel-surfaced roads that provide access to the dam, stilling basin, intake structures, and the reservoir. An administration building is located in a fenced compound on the right dam abutment, and a fuel dispensing station and flammable materials storage building are located approximately 200 feet north of the administration building on Access Road A.

Subsequent modifications of the dam structure were made following the emergence of a spring during a highwater period (up to elevation 1,161 feet) that occurred in February 1965. The spring broke out about 350 feet downstream from the downstream right abutment toe. The spring was controlled by a gravel blanket supported by a crib wall. In 1968, a drainage tunnel was constructed at elevation 1,100 feet and extending 640 feet into the right abutment. Twelve relief wells were drilled to intersect and extend 20 feet below the tunnel floor. This system appears to have adequately controlled abutment leakage during the flood pools experienced to date.

1.4.5.2 Tacoma Headworks

Tacoma's Headworks was completed in 1913 and is located at RM 61.0, which is 3.5 miles downstream of HHD. This diversion is the primary source of Tacoma's First Diversion Water Right Claim (FDWRC). The diversion supplies water to a pipeline (Pipeline No. 1) that carries water from the diversion dam south and west to Tacoma. The pipeline has a capacity of 113 cfs (72 million gallons per day [mgd]). Tacoma is proposing to construct another pipeline in the next few years (Second Supply Project [SSP]) from the diversion toward Tacoma over a more northerly route by way of south King County and Federal Way. The new SSP would have a discharge capacity of 100 cfs (65 mgd) and carry Tacoma's Second Diversion Water Right (SDWR) to Pipeline No. 4 near the Portland Avenue Reservoir in Tacoma. The operation of the SDWR diversion is subject to conditions specified in an agreement between Tacoma and the Muckleshoot Indian Tribe (MIT). Tacoma's activities are described here for reference only, due to their close association with operation of HHD and their effects on the fish and wildlife resources of the Green River.

The existing Headworks would be modified to allow diversion and transmission of water to the new pipeline and to improve fish passage and screening facilities. Construction activities proposed at the Headworks include: raising the existing diversion dam, realigning the existing

intake and trashracks, constructing a new pipeline from the existing settling basin to the portal of Tunnel No. 2 (approximately 700 feet downstream of the diversion dam), adding fish/debris screening and bypass facilities (to include an adult fish ladder leading to a trap, holding, and transfer facility), and reshaping the river channel downstream of the dam to accommodate the fish bypass facilities. The existing building would be razed and replaced at the same location with an insulated equipment storage building approximately 25 feet by 20 feet in size.

The existing concrete gravity diversion dam is 17 feet high with a crest length of 155 feet. The dam is founded on bedrock and both abutments are keyed into rock. Proposed construction at the dam includes raising the crest and abutments 6.5 feet, removing part of the existing variable depth spillway apron and replacing it with a level apron. During construction of the dam, Tacoma's water supply would temporarily be collected and conveyed through a conduit running from the diversion dam to the settling basin about 70 feet away or, alternatively, by pumping water from the pool behind the diversion dam into the nearby North Fork pipeline.

The existing intake is 20 feet wide and located in the right abutment immediately upstream of the existing diversion dam. Proposed construction at the intake includes cofferdam construction, extending and raising the existing intake, new trashracks, trash raking equipment, stoplogs, and dual slide gates. The new top of the intake would be 6.5 feet higher than the existing intake structure to accommodate higher water surface elevations resulting from raising the dam crest.

The existing Headworks have minimal fish screening facilities. The modified Headworks would incorporate a non-revolving screen design at the west end of the existing stilling basin and would involve the following construction activities: demolition and removal of the west end of the existing concrete settling basin structure; construction of a new automatically cleaned, vertical, wedgewire fish/debris screen structure approximately 100 feet long by 30 feet wide by 22 feet deep; and construction of a fish bypass that returns juvenile fish migrating downstream to a point below the dam in the Green River. The fish/debris screen surface area would be approximately 80 feet long and 13 feet high (1,040 square feet) and would be designed to meet the Washington State and federal screening criteria. Construction of the fish/debris screen structure would require removal of the existing north bank retaining wall.

The existing Headworks dam is currently impassable to upstream migrating fish. However, the proposed fish/debris screen bypass structure at the Headworks would incorporate provisions to allow future upstream fish passage. Instream work downstream of the dam would include filling and excavating to create a level spillway apron and excavating channels for fish attraction purposes. Under an Agreement between the Muckleshoot Indian Tribe and Tacoma, the existing Headworks would be modified by adding an adult fish ladder leading to a trap and holding facility, and a water-to-water transfer mechanism to transfer fish to transport trucks.

Approximately 700 feet of existing 7-foot-diameter concrete pipe between the existing settling basin and the upstream portal of Tunnel No. 2 would be taken out of service and replaced with a new 8-foot-diameter steel pipe. The pipe would include a bypass section for use during construction or maintenance of the fish/debris screen structure.

The impacts of modifications to the Headworks and construction and operation of the SSP are assessed in the SSP EIS and associated supplement and addendum, as well as other regulatory documentation such as the application for the USACE permit.

1.4.5.3 Hydromodification

Channels in the lower and middle Green River basin channels have undergone extensive physical transformation to provide for navigation, flood control, and land development. The result has been straightening and confinement of the river to a single channel without riparian vegetation (important for both habitat and water quality) and instream habitat structure.

Removal of woody debris from the stream channel was first performed in the mid-1850s to facilitate navigation. Drainage of wetland areas began in the lower Green River basins circa 1858 to provide land for agriculture and settling. As the region's population grew, floodplain pumping was initiated; the Black River pumping station was installed in 1971 to pump stormwater from the floodplain into the Green River mainstem.

Large scale levees were built beginning in the early 1900s to help prevent the floodplains of the lower Green River from flooding. Periodic levee construction and maintenance activities continue to the present to protect higher density population areas and specific residential areas. Bank protection measures have resulted in restricting or preventing active channel meandering and migration across the floodplain. A recent survey of the Green River below Flaming Geyser State Park determined that levees and streambank revetments on one or both banks accounted for between 10 and 30 percent of the length of three contiguous reaches above about RM 38.0, and between 60 and 80 percent of the length of three contiguous reaches running between RM 25.0 and RM 38.0 (Perkins 1993; Tacoma 2000).

1.4.5.4 BNSF Railroad

The Burlington Northern Sante Fe (BNSF) Railroad parallels the upper Green River for much of its length. The line was built by the Northern Pacific Railroad in 1886-1887 (USACE 1998a). The rail line proceeds out of Auburn and follows the river in an easterly direction, gaining elevation to the top of Stampede Pass at about the 3,700-foot elevation and then proceeds down the east side of the Cascade range along the Yakima River to Cle Elum. In 1983 the line became inactive. Thirteen years later, as a result of a local increase in container traffic at the ports of Seattle and Tacoma, BNSF (the former Northern Pacific Railroad) spent over 130 million dollars to reactivate and upgrade the line. This upgrade included expanding the rail bed by placing additional rock in the Green River, and improvements of the tunnel and snow shed at the pass. The line was reopened in 1997, and it is anticipated that as many as eight trainloads of cars would be routed through the Stampede Pass line on a daily basis when it reaches full operation.

In many places along the upper Green River from HHD to Stampede Pass, the rail line is adjacent to the Green River channel and separates the main channel from much of its natural floodplain. Disruption of river bed migration, loss of access to side channels and tributaries, and localized impacts from instream filling with rock and ballast for the rail bed have affected the physical and biotic environment in these reaches.

1.4.6 Current Operational Setting

HHD is currently operated under congressional legislation to provide flood control and low-flow augmentation. The USACE operates the project for flood control and maintains full storage capacity during the flood season, generally November through February (Figure G-06). Outside of this window, the dam is used to provide a target minimum flow of 110 cfs to benefit fish. The operation of the dam has evolved substantially since it went into operation in 1962.

1.4.6.1 Flood Control

HHD provides storage of 106,000 ac-ft for flood control from approximately October through March. The transition months, October and March are evaluated during real-time conditions to determine the need for providing 100% of the flood control allocation. Flood control storage is not needed outside of the winter period because the river adequately handles runoff from snowmelt and groundwater. The objective is to control flows in the Green River at Auburn at, or below, 12,000 cfs.

The winter flood control period spans the period of approximately October through March. During the winter season, the reservoir elevation would be maintained at, or below, 1,070 feet to provide a minimum of 104,243 ac-ft of storage for the regulation of floods on the Green River. This storage provides the maximum possible effective reduction of the approved standard project flood for near Auburn. The project regulates only 55% of the total drainage area above the station near Auburn. Therefore, it is not possible to provide total control of all floods in the basin. Flood events that require flood control regulation are expected to have a 50% chance of occurrence each year (USACE 1998b).

During flood control regulation, releases must not cause the Green River discharge to exceed the maximum objective flow of 12,000 cfs as measured at the USGS streamgage, Green River near Auburn, Washington (USACE 1996).

Flood control operations would make maximum beneficial use of available storage during each flood event and would be based upon a channel capacity that would safely carry a discharge of 12,000 cfs near Auburn. To provide a margin of safety against errors in forecasted local inflow, the project outflow would be regulated to control flows near Auburn to an objective flow of 10,000 cfs on a rising hydrograph. The objective flow would be increased during recession to evacuate storage as rapidly as practicable, the amount of increase to be based upon observed and forecasted precipitation and the shape of the recession hydrograph. Since the travel time between the dam and stream gage near Auburn is about 7 hours during high water, releases from the dam, plus forecast local inflow between dam and Auburn, must be combined to determine the Auburn discharge. On a flood recession the regulated discharge near Auburn may be increased to 12,000 cfs when conditions assure an accurate local inflow forecast.

The threat of flooding diminishes through the late winter and spring periods. Consistent with flood control requirements, spring refill may begin as early as February 15 (USACE 1998b).

Flows are released from HHD in three ways: (1) through a 48 in. "by-pass" (500 cfs capacity); (2) through the sluices and a 19' flood control tunnel (12,000 cfs capacity); (3) and over the gated spillway (capacity 108,000 cfs.) Normal floods that do not require the spillway are passed through the sluices and flood control tunnel. To prevent the undesirable release of water surges, a Special Gate Regulation Schedule is used to determine the maximum release rate for large floods. The schedule specifies maximum releases in an orderly manner as the reservoir rises so the reservoir elevation does not exceed design conditions. When increasing the outflow, the sluices would normally be operated with full open gates before water is discharged over the spillway. The maximum spillway outflow is 108,000 cfs with 12,000 cfs through the sluices and 4,400 cfs through the railroad notch at a maximum reservoir surcharge elevation of 1,223.9 feet. When the reservoir begins to fall after using the Special Gate Regulation Schedule, the maximum gate openings of the sluices and spillway would be maintained until the reservoir recedes to elevation 1,206 feet and/or it is possible to control the Auburn discharge to an applicable objective flow. (USACE 1996)

1.4.6.2 Low-Flow Augmentation

The existing reservoir provides for 25,400 ac-ft of summer/fall storage; 24,200 ac-ft is active storage available for augmenting instream flows below the project. The Green River is the principal source of municipal and industrial water supply for Tacoma. During the summer-fall low-flow period, the minimum release from HHD reservoir is made up of the 110 cfs for the fishery plus 113 cfs or inflow, whichever is least, for Tacoma. This storage volume has a 98% refill reliability of maintaining a minimum instream of 110 cfs at the Palmer gage (6 miles downstream of HHD). This storage volume and use has been considered enhancement of instream resources (including fish), not restoration, as provided under existing project authority. Augmenting flows during the summer and early fall alters the flow regime from HHD (RM 64) to the estuary (RM 7) during the period when 1) juvenile salmonids are rearing in the river; 2) steelhead eggs are incubating and fry are emerging, 3) adult chinook and coho salmon are migrating upstream; and 4) chinook salmon are spawning in the river. The existing storage volume and minimum flows are barely sufficient to provide for instream passage of adult salmon during low-flow years and are insufficient to keep steelhead eggs watered. Since 1987, Tacoma has voluntarily reduced their water supply diversion during at least 3 years to supplement HHD releases to maintain higher flows.

1.4.6.3 Spring Reservoir Filling

The spring reservoir filling period spans the period of approximately April through July. Beginning in January, inflow volume forecasts is made in accordance with paragraph 6.03b of the Water Control Manual. Utilizing the runoff forecast as a starting point, the refill plan is formulated through consultation with the various resource agencies. In concept, the plan, referred to as proportional capture, is to store a percentage of the runoff hydrograph so the shape of the reservoir discharge hydrograph is similar to the natural inflow hydrograph. Dam discharge always conform to the minimum discharge, rate-of-rise and rate-of-fall constraints.

The starting date of refill and percentage of runoff stored is determined by runoff simulation modeling utilizing historic runoff hydrographs as input to a Stella model of the Green River

basin with an initial goal of filling to elevation 1,141 feet (25,400 ac-ft of storage) by June 1. The refill plan is updated approximately weekly, incorporating observed runoff and updated runoff forecasts, if available, to vary the percent of capture to assure refill. This iterative process plus the recognition that snowmelt runoff extends beyond June 1, provide approximately 98 percent chance that filling to elevation 1,141 feet would be achieved.

The original Design Memorandum for Howard A. Hanson Dam (1954) considered that the flood potential was greatly reduced after March 1. The accumulation of conservation storage was proposed to start on April 1. The maximum conservation pool of 1,141 feet would be achieved by June 1. Following is a flood statement that summarized studies for the design memorandum, "The storage space available above the 1,141 limit is more than adequate to control any probable flood during April and May . . . the amount of water that would be stored below this limit would be adequate to satisfy the fishery requirement of 110 second-feet at Palmer from June through November." Fishery benefits were estimated on the basis of the increased production of fish that would result from improvement in spawning conditions along the river as a direct effect of increasing the summer flows.

1.4.6.4 Conservation Flows

The summer conservation period spans the period of approximately July through September. The reservoir would be held at maximum summer conservation elevation 1,141 feet until storage is required to augment flow or, in the case of considerable summer rainfall, it is apparent full storage would not be required. Normally, drawdown of the reservoir to meet low-flow augmentation demands usually begins in July and continues through September. In the event of an exceptionally dry fall, if storage is available, augmentation would continue until winter precipitation increases river base flow to a level adequate to sustain discharge below the Tacoma diversion above the 110 cfs minimum instream flow requirement. As soon as conditions indicate conservation storage is no longer needed, the reservoir would be drafted to 1,070 feet, or below, for flood control.

During the summer-fall low-flow period, the minimum release would be made up of 110 cfs for fishery enhancement plus 113 cfs or inflow, whichever is least, for Tacoma (USACE 1998b).

After refill is complete in the spring, the USACE would pass inflow and maintain the full conservation pool until water is needed from storage. Minimum discharge would be 110 cfs plus 113 cfs or inflow, whichever is least. The quantity of 113 cfs is from inflow and is for water supply diversion at Tacoma's intake. The quantity of 110 cfs is from storage and is for fishery enhancement below Tacoma's diversion. During some periods in the fall, discharges may be greater than normal for several days to encourage the upstream migration of anadromous fish. Such operations come from coordination with resource agencies and are usually granted provided adequate water is available in storage (USACE 1996). Operations described for the summer conservation period would extend as long as low-flow conditions persist. In extreme conditions, this could be as late as early December. The summer low-flow season begins with the reservoir at its maximum conservation pool level (elevation 1,141 feet). The reservoir would be held at this maximum until storage is required to augment the river flow. When there is considerable rainfall during the summer, full storage may not be required and the reservoir could

be drawn down along a schedule close to the guide curve. Normally, drawdown of the reservoir begins in July and continues through September. In the event of a dry fall, augmentation would continue if storage is available. As soon as conditions indicate that storage is no longer needed, the reservoir would be evacuated to prepare for flood control operations (USACE 1996).

Some deviation from normal operation and regulation can be expected during construction periods, either downstream of the project, or in the reservoir, during inspection of gates and other operational equipment, and during operations and testing for the fishery that may be performed from time to time by the USACE, or other interests. There have also been occasions in the past when special requests have been received from law enforcement agencies for reduced flows to search the river for drowning victims. These deviations would be considered on a case-by-case basis and any regulation coordinated between all parties concerned before being submitted to the USACE Northwest Division Office for approval (USACE 1998b).

Outflow would be passed through the 48-inch bypass as long as its discharge capacity is adequate. The discharge of the 48-inch bypass may be augmented by one of the sluices. However, very small openings of the sluice gates are avoided because of the potential for clogging by debris.

The 48-inch bypass affords the primary control of riverflow through the dam during the summer water conservation season when the reservoir pool elevation is 1,075 feet and above. During this season, the regulating gates are used only when the required discharge exceeds the capacity of the 48-inch bypass. (O&M 1972)

1.4.6.5 Section 1135 Water Storage

The HHD Section 1135 Project was initiated to increase the opportunity of flow augmentation to benefit downstream aquatic resources. In April 1997, approval was granted under Section 1135 of the 1986 Water Resources Development Act, as amended, to increase the volume of summer conservation storage contingent upon signing of the Local Cooperation Agreement (LCA) by the project sponsor, the City of Tacoma. The LCA was subsequently signed by Tacoma in 2000. The Section 1135 project provides for addition of up to 5,000 acre-feet of storage for flow augmentation. This will increase maximum storage level from elevation 1,141.0 to 1,147.1 and provide up to 29,200 acre-feet of conservation storage above the normal minimum pool elevation, 1,070.0. This water is currently targeted for drought year use (estimated at once every five years on average). Thus it provides minimal but critical restoration to supplement flows for benefit of downstream fisheries.

Prior to the Section 1135 Project, water was stored up to pool elevation 1,147 ft in some years to support debris collection operations within the reservoir. Once the debris collection was complete, the reservoir level was generally dropped to elevation 1,141 ft by releasing water over the next few weeks. Under the Section 1135 Project, during drought years, storage would be released during periods when reservoir inflow and conservation storage at HHD are not sufficient to maintain instream flows above 250 cfs at the Auburn gage. Under the adaptive management provision of the Section 1135 Project, the volume (up to 5,000 ac-ft), frequency of

storage and pattern of release can be modified on an annual basis in coordination with natural resource agencies and the Muckleshoot Tribe.

1.4.6.6 Sediment Management

Sediment from the watershed above HHD has been accumulating in the reservoir since the project began operation in 1962. As water is impounded behind the dam, the water velocity is greatly reduced and a large amount of fine and coarse sediment drops out. Results of the last survey conducted in 1993 indicate that approximately 1,769 ac-ft of sediment were deposited in the reservoir (USACE 2000a).

As the reservoir level is drawn down, water flow is channelized through the large sediment flats that have developed over time. As flow increases, erosion of accumulated sediment dramatically increases. This is accompanied by a sharp rise in turbidity of the reservoir discharge. The reservoir elevation at which significant erosion begins is known as the "turbidity pool" elevation. The City of Tacoma has a diversion just downstream from HHD, and is required to blend river water with pumped water when the river turbidity exceeds 5 NTU. Typically, the USACE makes every attempt to maintain the water level behind HHD so that it is above the turbidity pool, thus avoiding negative turbidity impacts downstream (USACE 2000a).

Periodically, and usually on an annual basis, the USACE seizes an opportunity to control the loss of reservoir storage space caused by sedimentation and the progressive rise in the turbidity pool. This is a special operation of the project whereby the reservoir is drafted in order to gently touch the turbidity pool while maintaining considerable project outflow. During this brief period of time, the water released from HHD is more turbid than usual and is closely monitored. With considerable project outflow (usually 2,000 cfs or more), the sediment from the turbidity pool largely remains suspended, and is transported to Puget Sound. This is considered to be a regular maintenance operation and is necessary to prevent a progressive increase in turbidity pool elevation. Without this operation, sediment would continue to accumulate and encroach into storage space that is required for flood control.

Preparation for turbidity pool operation begins about three days in advance, when inflow to HHD is forecast to be 2,000 cfs or greater. The ideal situation is for the reservoir to be a few feet above the turbidity pool about a day before the large inflows arrive. During the period when large inflows arrive, the reservoir is usually maintained at or near the turbidity pool elevation for as long as possible while an attempt is made to simply pass project inflow. After a few hours, the reservoir level generally begins to rise, and operation of HHD goes back to normal. On a few occasions, this operation has actually resulted in lowering of the turbidity pool, although the intent is simply to prevent it from growing.

The gate operations used for release of this flow would be similar to the operation for the flood flow releases.

1.4.6.7 Woody Debris Management

Winter floods bring floating debris, mostly in the form of wind-blown tree branches and entire trees, down from the upper reservoir area. The debris is held behind log booms until the temporary pool drops. During the spring, the debris floats again as the pool is raised for the low-flow augmentation season. The preferred storage area is used that requires a temporary pool raise elevation 1,141 feet to 1,147 feet.

During periods of high water, most of the floating debris is collected at three stationary log booms. Debris trapped by the booms is collected in sack booms and towed by barge to the temporary holding areas. Larger floating and sunken debris passing the booms may lodge against the intake structure trash rack bars and is removed periodically.

Debris that isn't collected at the log booms or trash rack can pass through the outlet tunnel and on downstream.

When the conservation pool is at the maximum elevation, the debris is towed from the temporary holding areas to the holding and burning areas. When the pool level has been lowered and ground conditions permit operations in the burning areas, the sack booms and salvageable materials are removed and the unsalvageable materials sawed to convenient lengths and piled by bulldozers for burning.

1.4.6.8 Temperature Control

Water impounded in the reservoir becomes thermally stratified in early summer, a condition that continues through the fall, the onset and duration depending upon the amount of water in storage and hydroclimatological conditions. Selective withdrawal facilities are not available. Withdrawing water through either the sluices or 48-inch bypass at 1,069 feet or below, provides water temperatures below inflow conditions during the early summer. By early fall, the cool water in the bottom of the reservoir has been used up and releases begin to be warmer than inflow (USACE 1998b).

1.4.6.9 Daily/Periodic Operation and Maintenance

Normal Operation
Collecting, recording, and reporting data are routine functions required at all USACE projects, including HHD. Each normal workday, project personnel collect the maximum and minimum air temperature, snowfall and snow depth, and precipitation in the manual gage. This information, along with daily precipitation and turbidity readings obtained from Tacoma's headworks station, are reported to HHD. Project personnel collect inflow and outflow temperature and turbidity once per work day.

Additionally, USACE personnel are responsible for inspection and maintenance of all facilities associated with HHD (dam, equipment, painting, piezometers/wells, and roads).

Emergency Operation
Some deviation from normal operation can be expected during construction periods, either downstream of the project or in the reservoir, during inspection of gates and other operational equipment, and during operations and testing for the fishery that may be performed from time to time by the USACE or other interests. There have also been occasions when special requests have been received from law enforcement agencies for reduced flows to search the river for drowning victims. The USACE coordinates special requests with resource agencies (MIT, WDFW, etc.) when possible.

Upper Basin Monitoring and Equipment Maintenance
Monitoring and equipment maintenance is conducted by HHD project personnel on a periodic basis (Olson 2000).

1.5 STUDY APPROACH

1.5.1 Report Organization

This Conceptual Design Report provides general project information, typical habitat components, and detailed discussions of each proposed mitigation/restoration site. Chapter 1 addresses the study authorization, study objective, project location, background, and study approach. Chapter 2 discusses specific types of typical fish habitat components as a precursor to detailed site discussions. Fish habitat sites are grouped into specific habitat improvement types (gravel nourishment, mainstem improvements, and tributary improvements) and discussed in detail. The wildlife sites are similarly grouped into specific improvement types (managed pasture, forest management, and emergent marsh/sub-impoundment) and discussed in detail. Target mitigation acres and proposed action acres for each wildlife site are provided in the Wildlife Sites table preceding the Wildlife Habitat section. Total budget acreage for the three improvement types have been achieved and summarized in the Wildlife Sites table. Two GIS figures are included identifying the fish and wildlife sites and showing the geographic relationship of the sites in the Green River Basin. Appendices include references and selected individual reports that have been cited in this document.

1.5.2 Information Provided by USACE

HDR was provided copies of the following documents and/or reports by the USACE:

- USACE Howard Hanson Reservoir topography, E-sized maps - 7 sheets (2 of 8 through 8 of 8), 1961
- Howard Hanson Dam Section 1135 PMR and EA for Fish and Wildlife Restoration Project, July 1996.
- Howard Hanson Dam Additional Water Storage Project Final Feasibility Study Report & Final EIS, August 1998.
- Tacoma Water HCP Section 5.2.8 Habitat Conservation Measure: HCM 2-08, Downstream Woody Debris Management Program, July 1999.
- Project write-ups and miscellaneous notes for each fish site, written by Fred Goetz, USACE.

- Data on HHD operation in the form of a spreadsheet and PowerPoint files (electronically via email, December 1999).
- Programmatic Biological Assessment for Continued Operation & Maintenance and Phase I of the Additional Water Storage Project. April 2000.

1.5.3 Site Visits and Field Notes

Several field trips were conducted by the project team in late-summer/early-fall of 1999 to visit the proposed sites. Documentation of the site visitations was presented in the *Howard Hanson Dam, Additional Water Storage Project – Phase I, Fish & Wildlife Mitigation and Restoration, Field Notes*, December 10, 1999. That document provides an overview of existing conditions/considerations and potential design alternatives that were discussed in the field.

1.5.4 Project Team Consultation Meetings

To optimize the proposed fish and wildlife benefits achieved by the overall project, several collaborative meetings were conducted:

- **Forest Management Consultation-March 29, 2000**
  Tacoma Water has in place forest management practices with which the proposed forest management practices, presented in the Conceptual Design Report, must be compatible. Because forest management practices are integral elements of both the fish and the wildlife sites, direct consultation with Tacoma Water for one-half day occurred to fully understand their current and proposed forest management practices. The meeting was documented in a Meeting Report (Appendix H of this report).

- **Fish Site Consultation-April 3/4, 2000**
  One and one-half days of meetings were held with the USACE, USFWS, Tacoma Water, HDR, and Inter-Fluve to discuss and reach agreement on the proposed features for each of the conceptual fish designs. Further development of the design drawings for each fish site was facilitated by these detailed discussions and by determining mutually agreeable conclusions.

- **Large Woody Debris Consultation-April 6, 2000**
  The extensive use of large woody debris as a habitat improvement feature occurs throughout the fish sites. For this reason, USACE staff, Tacoma Water, HDR, and Inter-Fluve consulted with Springwood Associates for a full day to discuss how to best utilize and depict LWD. These consultations focused on the use of Bar Apex and Meander Jams.

- **Wildlife Consultation-April 12, 2000**
  A one-day meeting was conducted between the USACE, Tacoma Water, and HDR to discuss the conceptual designs for each of the wildlife sites. Further development of the text and drawings for the wildlife sites, in accordance with the discussions and conclusions of these meetings, occurred as follow-up.

- **Joint Fish and Wildlife Consultation-April 13/14, 2000**
  Following the completion of the independent fish and wildlife meetings, the USACE, Tacoma Water, and HDR met for two days to discuss joint fish and wildlife sites (those sites which either overlap or are immediately adjacent to one another). The purpose of the joint consultation was to determine the optimization of proposed mitigation and enhancement measures for each of the joint sites. USFWS was represented at one of the meetings.

1.5.5 Report Development

The development of the *Howard Hanson Additional Water Storage Project – Phase I Fish and Wildlife Mitigation and Restoration Conceptual Design Report* document has been a multi-step process. Site information/data and potential design alternatives were gathered (fall 1999) and synthesized into the Field Notes document. An initial draft conceptual design report was produced in late-December 1999, which transformed data from the Field Notes into a formal document describing each site, its criteria and considerations, and the proposed action and other alternatives. Aerial photography maps of each site were included, highlighting and describing the proposed action. USACE, Tacoma and USFWS participated in a review of the draft document and comments were provided to HDR. A series of meetings, involving the staff from USACE, Tacoma Water, and HDR, were subsequently held to provided the necessary interaction to create this comprehensive draft document. Following USACE and agency review, a final version of the *Howard Hanson Additional Water Storage Project – Phase I Fish and Wildlife Mitigation and Restoration Conceptual Design Report* will be produced. Follow-on future steps would be the development of the final designs and initiation of construction.

1.5.6 Regulatory and Permitting Considerations

The following permits, approvals, and/or consultations may be required to implement the proposed mitigation/restoration projects:

- **U.S. Army Corps of Engineers**
  Section 404 Clean Water Act/Section 10 Rivers and Harbors Act. An evaluation of compliance with the Regulatory program of the USACE will be completed associated with any pertinent work within waters of the United States (including wetlands).

- **Washington Department of Fish and Wildlife**
  The USACE will be in consultation with the WDFW to assure adherence to the State's Hydraulic Code. Hydraulic Project Approval (HPA) – The Sponsor or contractor will be required to get an HPA for construction activities off the federal reservation for habitat work below the ordinary high water mark.

- **Washington Department of Ecology**
  Clean Water Act Section 401 Water Quality Certification. The USACE will submit a request for certification with State water quality standards for any discharge into waters of the United States, including wetlands. Certification would be required for USACE-authorized projects that result in any discharge into surface waters or wetlands.

Clean Water Act Section 402 National Pollutant Discharge Elimination System (NPDES). The USACE will apply for General Permit authorization for stormwater discharges associated with construction activities.

Coastal Zone Management Act (CZMA) Consistency Evaluation. The USACE will develop a CZMA consistency evaluation for the proposed work. This will be submitted to the Washington Department of Ecology for concurrence. Certification is required for USACE-authorized projects located in any of the 13 coastal counties of Washington State.

- **Washington Office of Archaeology and Historic Preservation**
  Section 106 Review. A USACE permit triggers review under Section 106 of the National Historic Preservation Act of 1966. The Act requires that all federal agencies take into account the effect of its actions on historic properties. Seattle District will need to complete a Memorandum of Agreement (MOA) with the State Office of Historic Preservation (SHPO) regarding the existing project and the AWSP.

- **King County**
  Seattle District will coordinate with King County on construction activities on the federal reservation. The Sponsor or contractor will be responsible for any local permits for activities outside the federal reservation.

- **Burlington Northern Santa Fe Railroad (BNSF)**
  Easement/Permit. Approval would be required from BNSF for project features within their right-of-way.

- **Bonneville Power Administration (BPA)**
  Easement/Permit. Approval would be required from BPA for project features within their right-of-way.

- **Puget Sound Energy (PSE)**
  Easement/Permit. Approval would be required from PSE for project features within their right-of-way.

- **Endangered Species Act (ESA)**
  In addition to the PBA prepared for the ESA consultation for the on-going O&M activities at HHD and for the proposed AWSP, a Supplemental Biological Assessment (SBA) will be necessary to cover activities for construction of the habitat projects and fish passage facility. Preparation and submittal of the SBA to the Services will likely occur during the final design phase.

The exact permitting/regulatory requirements will be determined at the final design stage of the project.

1.5.7 Agency, Industry, Organization, & Tribal Cooperation

The Services, other resource agencies, and the Muckleshoot Indian Tribe (MIT) were invited to attend the field trips. During the USACE's Feasibility Study, members of all agencies and the MIT attended one or more meetings where project concepts were introduced and discussed. The USFWS also attended one of the joint fish and wildlife collaborative meetings as noted above.